

Comparison of 4 Questionnaires for Assessment of Fruit and Vegetable Intake

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Introduction

Diets rich in fruits and vegetables are associated with a decreased risk of many chronic diseases.¹⁻⁷ Both the National Cancer Institute^{8,9} and the *Healthy People 2000* objectives¹⁰ include the goal of increasing consumption of fruits and vegetables to 5 or more servings per day.

Progress toward meeting this national dietary goal can be monitored via relatively inexpensive and brief assessment tools. Multiple 24-hour recalls collected on nonconsecutive days are considered the best measure of dietary intake¹¹; however, they are labor intensive in that they involve a trained interviewer. Given cost constraints in large studies, a single recall or food frequency questionnaire is usually used. We compared the performance of 4 self-administered questionnaires with the mean of three 24-hour diet recalls to assess their ability to estimate prevalence and correctly classify and rank adolescents in terms of their fruit and vegetable intake.

Methods

Instruments

Youth Risk Behavior Surveillance System questionnaire. This questionnaire, developed at the Centers for Disease Control and Prevention,¹² contains 4 questions assessing fruit (fruit, fruit juice) and vegetable (green salad, cooked vegetables) intake. Each question asks the respondent how many times (0 to 3 or more) he or she consumed the item on the previous day.

Behavioral Risk Factor Surveillance System questionnaire. In the current study, this instrument, designed to assess dietary intake among adults, was modified from a telephone- to a self-administered format. We created a yesterday and a past-year version, both of which contained 2 questions about fruits (fruit and fruit juice) and 4 questions about vegetables (salad, potatoes [not including fries or chips], carrots, and other vegetables). The response categories on the yesterday version were identical to those on the Youth Risk Behavior Surveillance System questionnaire (i.e., 0 to 3 or more times). The categories on the past-year version ranged from 0 to 5 or more times per day.

Harvard Food Frequency Questionnaire.

This validated self-administered, semiquantitative food frequency questionnaire, which assesses dietary intake over the previous year,^{13,14} contains 12 questions on fruit and juice intake and 15 questions on vegetables (not including fried potatoes). The response options ranged from less than once per month to 2 or more servings per day.

Twenty-four-hour recalls. The three 24-hour diet recalls were collected on nonconsecutive days by registered dietitians using the University of Minnesota's Nutrient Data System. Servings of fruits and vegetables were calculated according to the University of Minnesota algorithm.¹⁵ The average number of fruit and vegetable servings reported on three 24-hour recalls was the gold standard against which we assessed the validity of the 4 questionnaires.

Sample

Between March and May of 1995, the Youth Risk Behavior Surveillance System questionnaire and the Harvard Food Frequency Questionnaire were administered during mandatory physical education classes and homeroom periods to students from a large urban high school with a student body diverse in terms of socioeconomic status and ethnicity. Eighty-eight percent (n = 1557) of English-speaking students who regularly attended school completed the questionnaires.

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ABSTRACT

Objective. This study compared fruit and vegetable assessments derived from 4 self-administered questionnaires.

Methods. Among 102 adolescents, servings of fruits and vegetables assessed by 4 questionnaires were compared with estimates from 24-hour recalls.

Results. The prevalence of consuming 5 or more servings of fruits and vegetables a day was underestimated by the questionnaires. Questionnaires asking subjects to recall their diet over the previous year were more effective in ranking subjects (r 's $\geq .42$) than those assessing previous-day diet (r 's $\geq .30$).

Conclusions. Brief assessments of fruit and vegetable intake are more useful for ranking subjects than for estimating prevalence of consumption of 5 or more servings per day. (*Am J Public Health.* 1998;88:1216-1218)

Study Protocol

A random sample of 120 students was selected for the validation study, which was conducted over 10 to 12 weeks. Participants completed three 24-hour recalls, each conducted approximately 2 weeks apart; in addition, they completed the Youth Risk Behavior Surveillance System questionnaire and the Harvard Food Frequency Questionnaire a second time. Directly preceding the second 24-hour recall, the yesterday version of the Behavioral Risk Factor Surveillance System questionnaire was administered, and, preceding the third 24-hour recall, the past-year version was administered. Approximately 2 to 4 weeks after the third 24-hour recall, the Youth Risk Behavior Surveillance System questionnaire and the Harvard Food Frequency Questionnaire were again administered. This last administration was used in all validation analyses.

Sample for Analysis

Students who did not complete the second administration of the Youth Risk Behavior Surveillance System questionnaire and the Harvard Food Frequency Questionnaire ($n = 6$), who were missing 1 or more 24-hour recalls ($n = 5$), who gave implausible values on the 24-hour recalls ($n = 1$) or the Harvard Food Frequency Questionnaire ($n = 7$), or who were outliers on the Harvard Food Frequency Questionnaire¹⁶ ($n = 3$) were excluded from the analyses, leaving 102 students. Two additional students were excluded from the Behavioral Risk Factor Surveillance System questionnaire past-year analyses because they skipped 1 or more fruit or vegetable questions. The sample comprised approximately equal numbers of male and female students and was racially diverse (35% White, 24% African American, and 15% Hispanic).

Because the yesterday version of the Behavioral Risk Factor Surveillance System questionnaire was administered on the same day as the second 24-hour dietary recall, the 2 measures were highly correlated. Averaging the 3 recalls did not sufficiently dampen the artificially strong correlation driven by the correlation with the second recall. Therefore, in validation analyses involving the yesterday version, the second recall was excluded.

Statistical Analyses

We compared the prevalence of students consuming 5 or more servings per day of fruits and vegetables from the self-report instruments and the 24-hour recall data. McNemar's test was used to test the significance of differences. Sensitivity, specificity, and predic-

tive values were computed. Spearman rank correlations were used to assess the validity of estimated servings of fruits and vegetables (alone and combined). All analyses were conducted with SAS software.¹⁷

Results

According to the average of three 24-hour recalls, 50% of the students consumed at least 4.9 servings a day of fruits and vegetables, and 49% consumed an average of at least 5 servings a day (Table 1). In comparison with the recalls, all of the questionnaires significantly underestimated the proportion of students consuming at least 5 servings of fruits and vegetables (Table 1). Average underreporting of servings of fruit was minimal (0.07 on the Youth Risk Behavior Surveillance System questionnaire, 0.01 on the past-year Behavioral Risk Factor Surveillance System questionnaire, and 0.16 on the Harvard Food Frequency Questionnaire), except on the yesterday version of the Behavioral Risk Factor Surveillance System questionnaire (0.71 servings). However, average underreporting of servings of vegetables ranged from 1.1 (past-year Behavioral Risk Factor Surveillance System questionnaire) to 1.5 (Youth Risk Behavior Surveillance System questionnaire) servings per day.

The sensitivities of all 4 questionnaires were low to moderate (Table 1). Prevalence underestimation translated into good specificity (0.75 to 0.87) on all of the self-report instruments. The Harvard Food Frequency Questionnaire and both versions of the Behavioral Risk Factor Surveillance System questionnaire did a comparable job of classifying people as meeting the 5-a-day goal (positive predictive values of 0.67 to 0.73). The Youth Risk Behavior Surveillance System had a slightly lower positive predictive value (0.61).

The Spearman correlations between the self-report instruments and the recalls are shown in Table 2. Relations for the yesterday and past-year versions of the Behavioral Risk Factor Surveillance System questionnaire and for the Harvard Food Frequency Questionnaire were similar for fruits and fruit juice (Table 2). The correlations with the Youth Risk Behavior Surveillance System questionnaire were much lower. The Harvard Food Frequency Questionnaire and the past-year version of the Behavioral Risk Factor Surveillance System questionnaire performed equally in regard to vegetable intake. As a result of the relatively poor assessment of vegetable intake by the questionnaires assessing intake on the previous day, both the Youth Risk Behavior Surveillance System questionnaire and the yesterday version of the Behavioral Risk Factor Surveillance System questionnaire had

lower correlations than the past-year Behavioral Risk Factor Surveillance System questionnaire and the Harvard Food Frequency Questionnaire (Table 2) with total fruit and vegetable intake based on the recalls.

Discussion

Based on the average of three 24-hour recalls, 49% of the students in this study were consuming at least 5 fruits and vegetables a day. However, according to the self-report questionnaires, the prevalence was between 25% and 36%. Underestimation of fruit and vegetable intake was primarily due to underreporting of vegetable intake. On the Youth Risk Behavior Surveillance System questionnaire, this was partially due to the fact that only cooked vegetables and salad were assessed. Underestimation on all 4 questionnaires may reflect that the prevalence of vegetables consumed in mixed dishes¹⁸ (which may be forgotten) is as high as 29%.

We observed that not all of the individuals identified by the questionnaires as meeting the 5-a-day goal were similarly classified by the recalls. Nevertheless, the Harvard Food Frequency Questionnaire and both versions of the Behavioral Risk Factor Surveillance System questionnaire did a comparable job of classifying people as meeting the goal. In addition, the past-year version of the Behavioral Risk Factor Surveillance System Questionnaire provided the estimate of total fruit and vegetable intake that was closest to that of the average of three 24-hour recalls.

The self-report instruments assessing fruit and vegetable consumption over the previous year were more effective than those assessing diet on the previous day in ranking subjects. The correlations were strongest with the past-year Behavioral Risk Factor Surveillance System questionnaire. These results suggest that the performance of the questionnaire was not compromised by specifying a past-year time frame or transforming it from telephone-administered to self-administered. Moreover, the results imply that the use of 6 items (Behavioral Risk Factor Surveillance System questionnaire) instead of 4 (Youth Risk Behavior Surveillance System questionnaire) improves the performance of the questionnaire only when a past-year time frame is adopted.

The high participation rate and ethnic diversity of the sample make the results generalizable to English-speaking non-White populations and populations with lower intakes of fruits and vegetables. Sensitivity and specificity are not affected by prevalence; however, predictive values may be different in a population with much lower fruit and vegetable intakes.

TABLE 1—Sensitivity, Specificity, Positive Predictive Value, and Negative Predictive Value of Fruit and Vegetable Servings According to the Youth Risk Behavior Surveillance System (YRBSS) Questionnaire, Behavioral Risk Factor Surveillance System (BRFSS) Questionnaire, and Harvard Food Frequency Questionnaire (HFFQ): 102 High School Students

	Servings per Day of Fruits and Vegetables, Median	Prevalence of 5 Servings per Day, %	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
24-hour recalls ^a	4.9	49.0
YRBSS	4.0	32.4*	0.40	0.75	0.61	0.57
BRFSS: yesterday ^b	3.0	25.5***	0.38	0.87	0.73	0.59
BRFSS: past year	3.7	36.0**	0.48	0.76	0.67	0.59
HFFQ	3.2	26.5***	0.38	0.85	0.70	0.59

^aThe mean of three 24-hour recalls was the gold standard against which the instruments were compared.

^bIn comparison with mean of first and third recalls.

* $P < .01$; ** $P < .02$; *** $P < .001$.

TABLE 2—Spearman Correlations between Self-Reported Fruit and Vegetable Intake on the Youth Risk Behavior Surveillance System (YRBSS) Questionnaire, Behavioral Risk Factor Surveillance System (BRFSS) Questionnaire, and Harvard Food Frequency Questionnaire (HFFQ) and the Mean of Three 24-Hour Recalls: Students at an Urban Public High School in the Northeast

	Fruit Only	Fruit Juice	Fruit and Juice	Vegetables	Fruit (Including Juice) and Vegetables
YRBSS	0.17	0.07	0.21	0.24	0.28
BRFSS: yesterday ^a	0.33	0.30	0.34	0.14	0.30
BRFSS: past year	0.36	0.36	0.35	0.33	0.43
HFFQ	0.33	0.29	0.33	0.32	0.41

Note. The 24-hour recalls were the gold standard against which the instruments were compared.

^aCompared with mean of first and third recalls.

These results provide evidence that high school students are able to compute average fruit and vegetable intake during the past year and suggest that brief assessments of intake are more useful for ranking subjects than for estimating prevalence of consumption of 5 or more servings per day. □

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